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(54) **ELECTRIC MOTOR ASSEMBLY FOR RAILWAY DRIVE**

USPC 310/51, 52, 53, 54, 64
See application file for complete search history.

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 701 days.

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(Continued)

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(30) **Foreign Application Priority Data**

(57) **ABSTRACT**

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An electric motor assembly for railway drive. The motor assembly comprises:

(51) **Int. Cl.**
H02K 5/24 (2006.01)
B61C 3/00 (2006.01)
H02K 9/06 (2006.01)
H02K 5/20 (2006.01)
H02K 11/33 (2016.01)

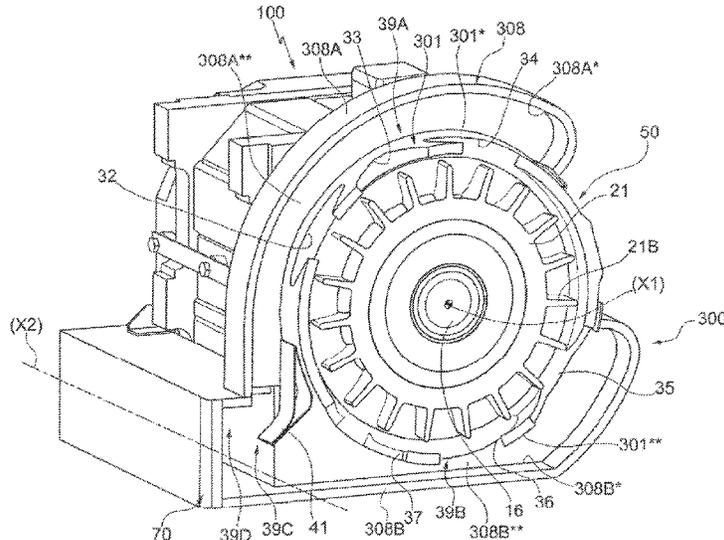
an electric drive motor;
a ventilation and cooling device for ventilating and cooling the electric drive motor through cooling air; and
a draining device to drain the ventilation and cooling air flow.

(52) **U.S. Cl.**
CPC **H02K 5/24** (2013.01); **B61C 3/00** (2013.01); **H02K 5/20** (2013.01); **H02K 9/06** (2013.01); **H02K 11/33** (2016.01); **H02K 2205/09** (2013.01)

The draining device is provided with a silencer device for the cooling air flow. The silencer device comprise at least one straight channel to reduce the turbulent flow into a substantially laminar flow of the out-flowing ventilation and cooling air. Furthermore, the draining device comprises a scroll, which consists of two separate arched channels in order to avoid the formation of stationary vortices. The two arched channels communicate with one another, from the fluidic point of view, only in a common outlet area for the ventilation and cooling air.

(58) **Field of Classification Search**
CPC ... B61C 3/00; H02K 5/20; H02K 5/24; H02K 9/06; H02K 9/20; H02K 9/24; H02K 11/33; H02K 2205/09

10 Claims, 6 Drawing Sheets



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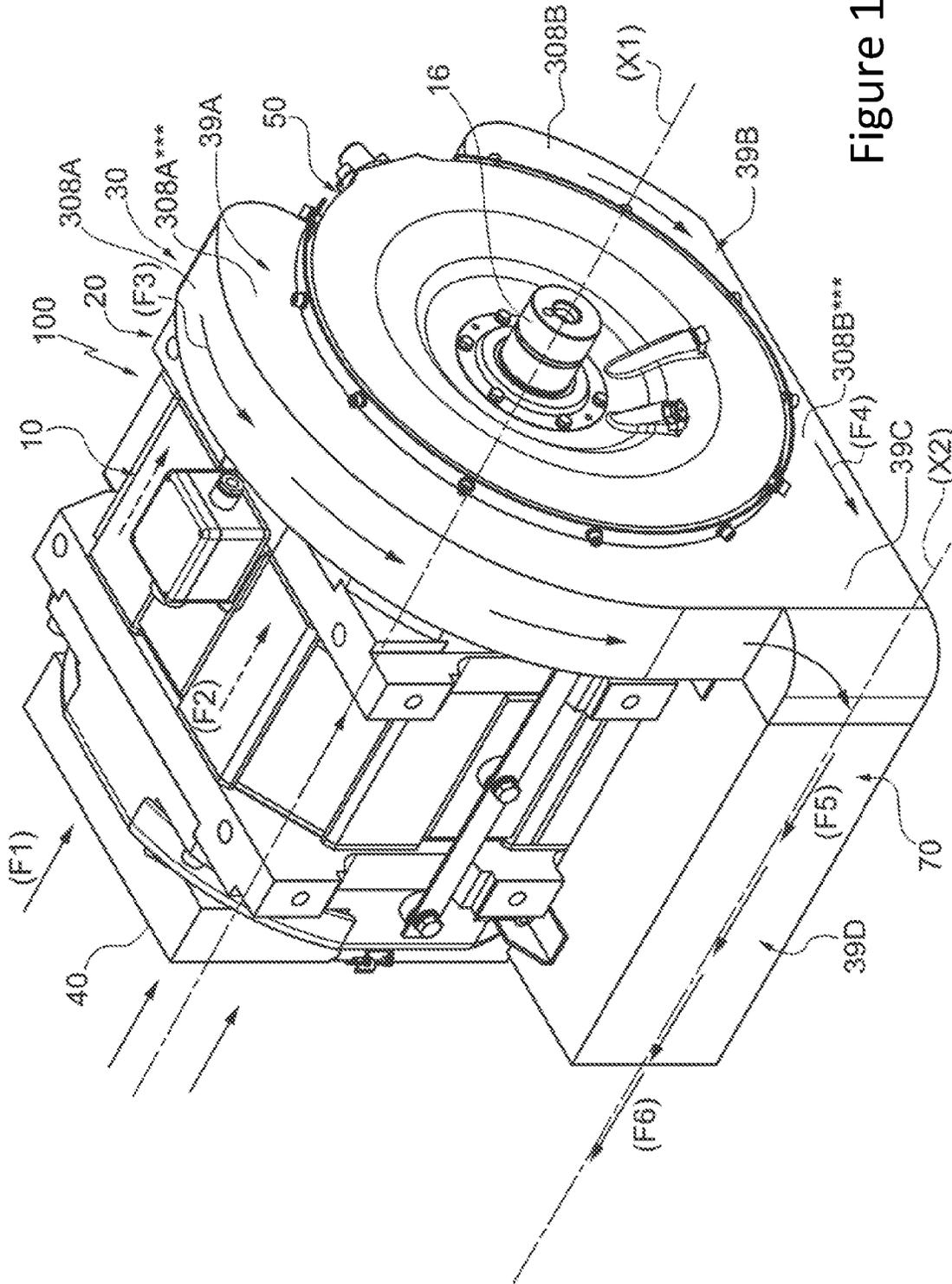


Figure 1

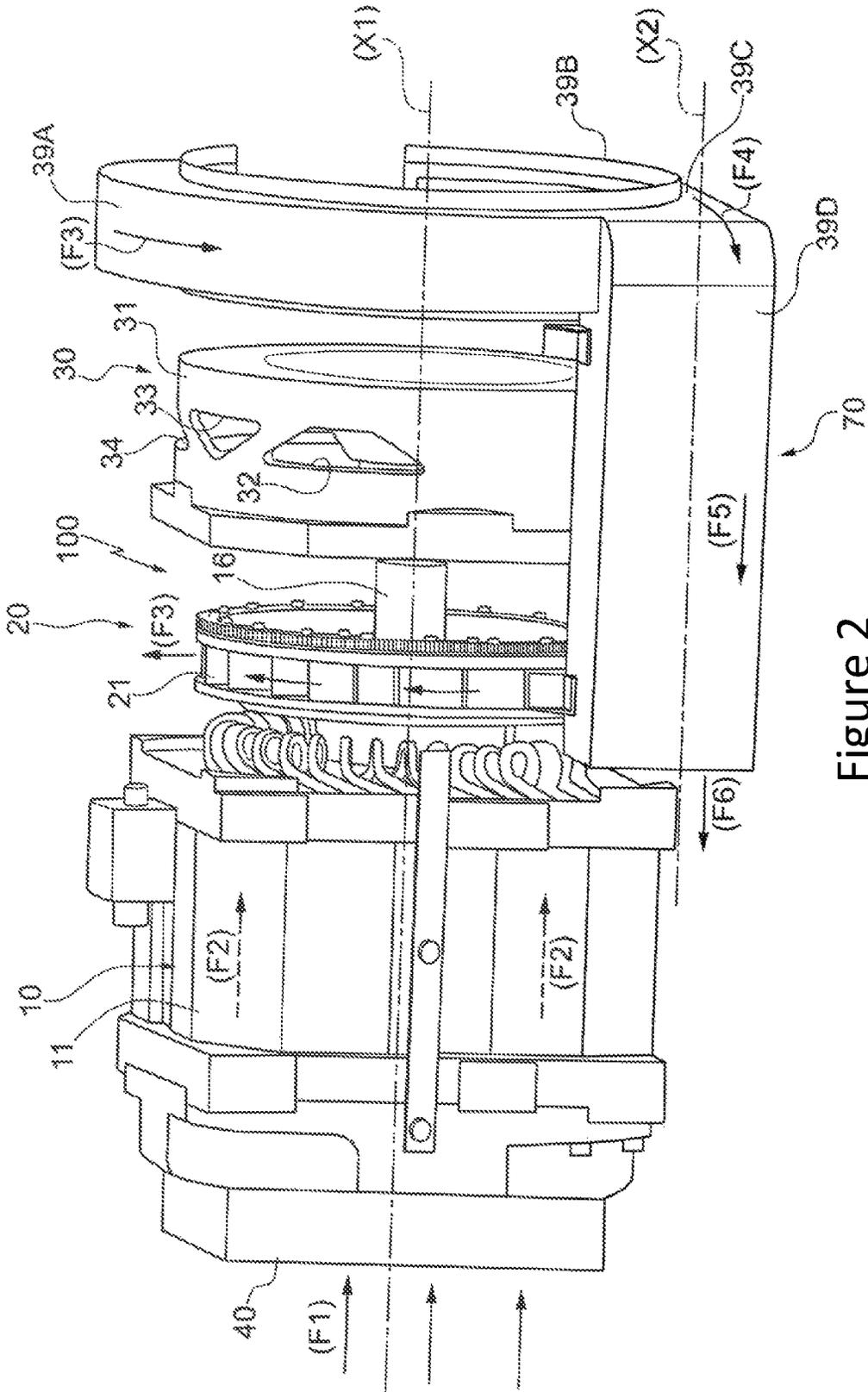


Figure 2

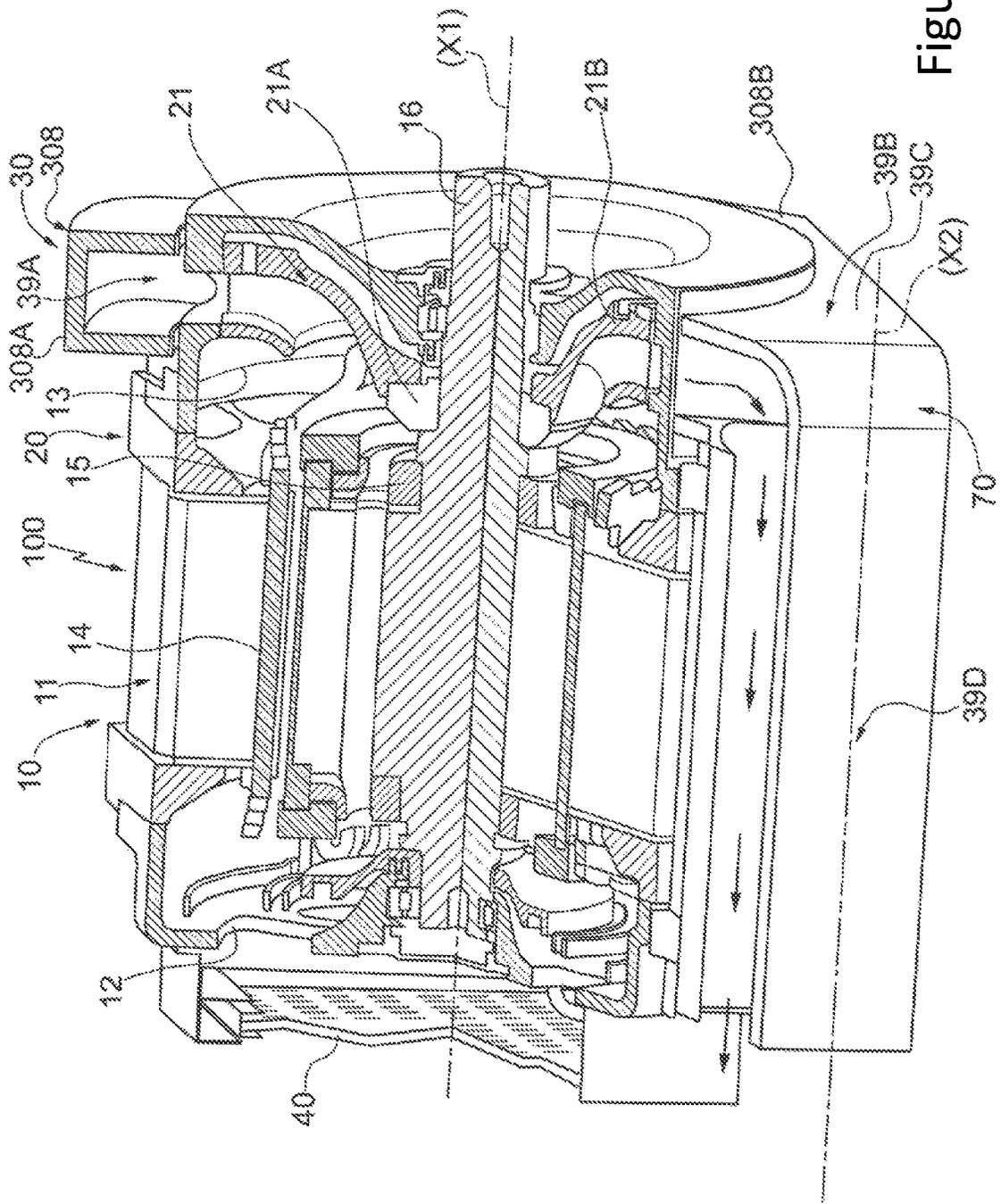


Figure 3

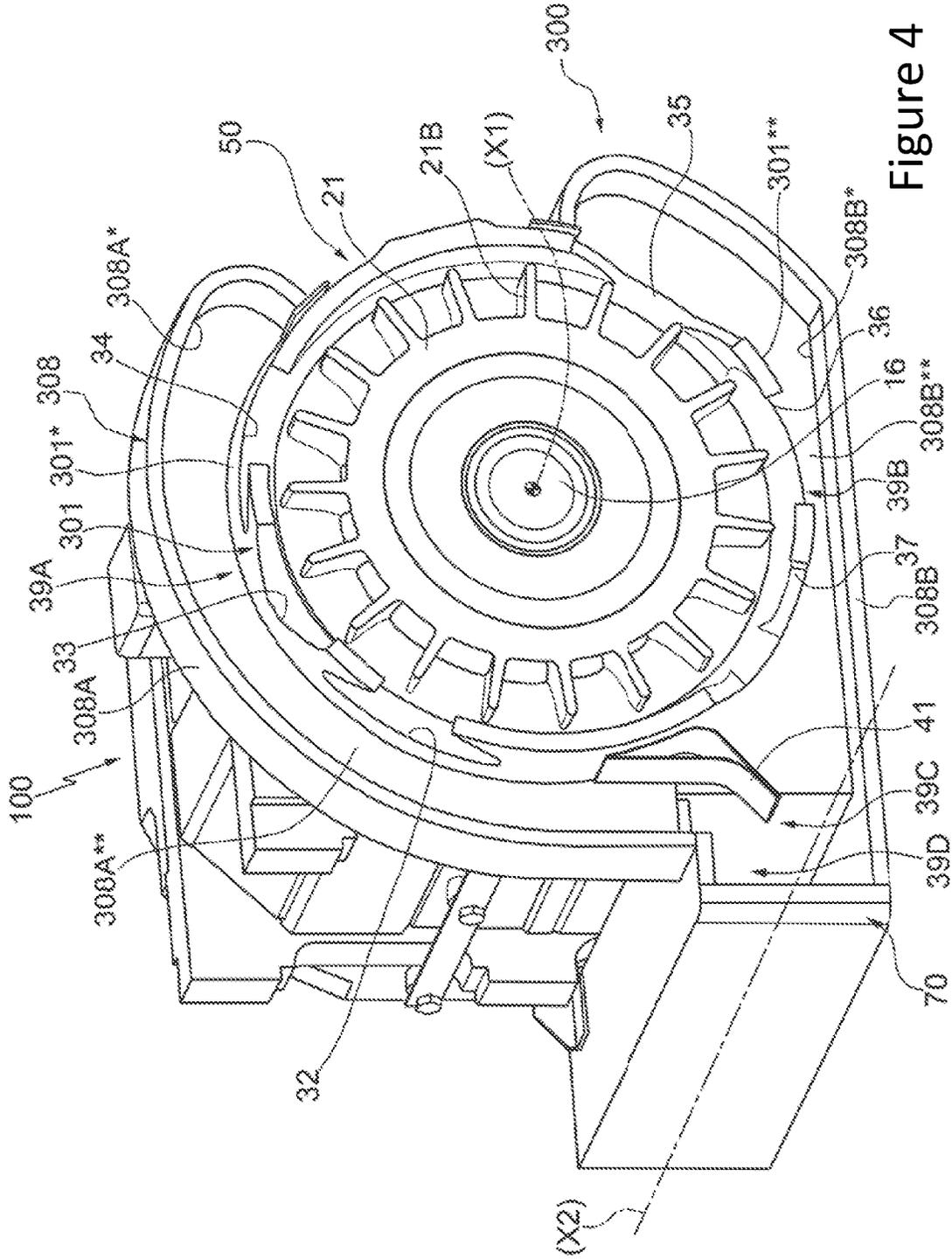


Figure 4

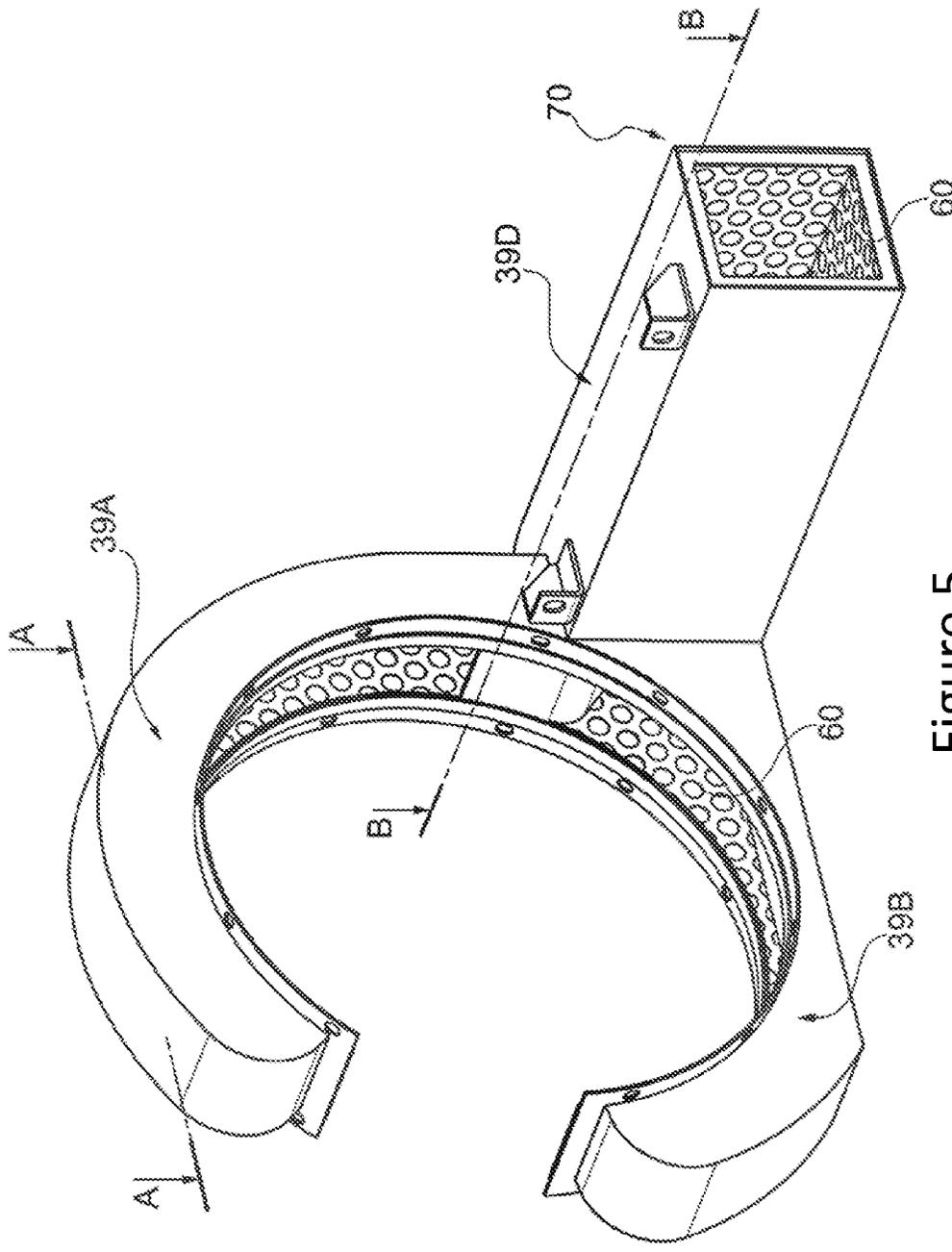


Figure 5

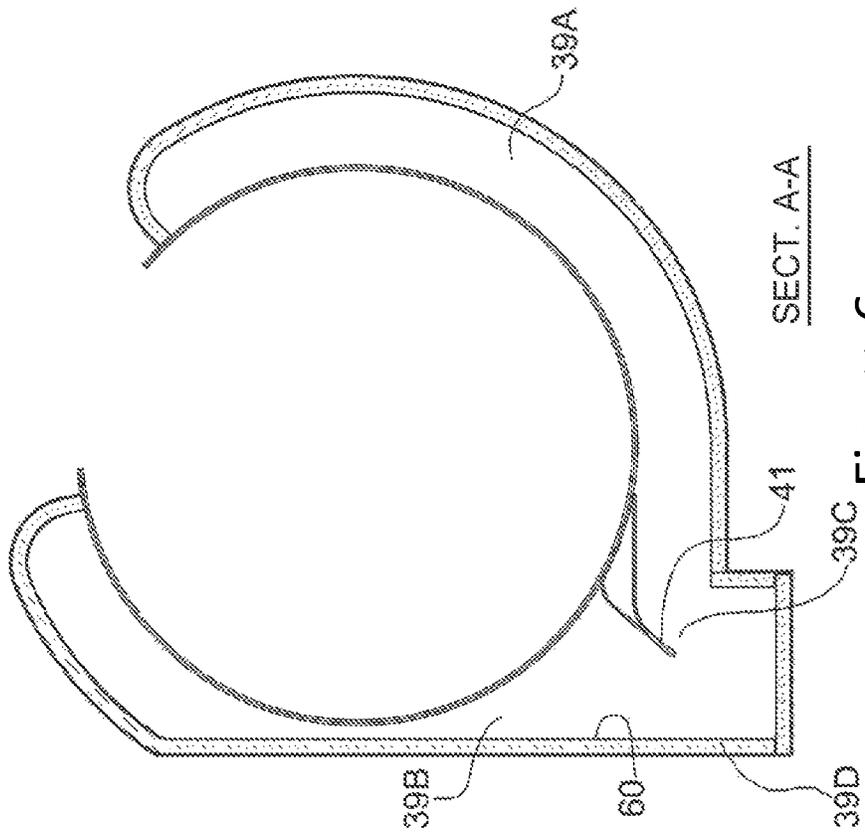


Figure 6

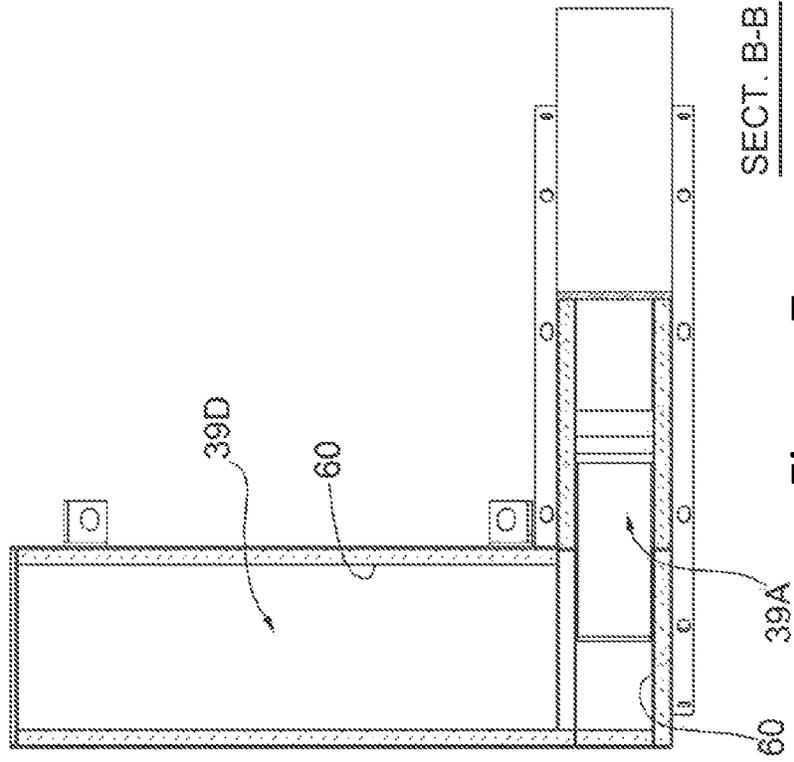


Figure 7

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**ELECTRIC MOTOR ASSEMBLY FOR
RAILWAY DRIVE****CROSS-REFERENCE TO RELATED
APPLICATIONS**

This application claims priority from Italian Patent Application No. 102017000087339 filed on Jul. 28, 2017, the disclosure of which is incorporated by reference.

TECHNICAL FIELD

The invention relates to an electric motor assembly for railway drive.

BACKGROUND OF THE INVENTION

As it is known, environmental standards establish limits that are becoming stricter and stricter in terms of train sound emissions.

A significant source of these sound emissions is the electric drive motor, in particular the motor having a so-called "self-ventilated" ventilation system.

In the self-ventilated ventilation system, the motor cooling flow is generated by a fan, which is directly fitted onto the shaft of the motor.

Furthermore, it is known that in recent year there has been a shift from "locomotive-drive" systems, in which the sole locomotive at the head of the train was responsible for driving itself and the other wagons, to railway drive means, in which each carriage is self-moving and, therefore, is provided with autonomous moving means.

Therefore, this has led to a significant increase in the number of drive systems of each train.

According to noise measurements carried out according to the standards currently enforced, along the shafts of the motor the emission is greater than the one generated by the cooling fan.

The problem of noise damping in electric motors has been taken into account in the following documents:

JP-A-2002 233104

JP-A-2005 312242

WO-A1-97/37421

CH-A-495 651

each of which illustrates, if taken individually, the preamble portion of claim 1.

Hence, there is the need to find a simple and effective system to reduce the noise of electric drive motors used in the railway field.

SUMMARY OF THE INVENTION

Therefore, the object of the invention is to provide an electric motor assembly, in particular for railway drive, which is not affected by the above-mentioned drawbacks.

As a consequence, according to the invention, there is provided an electric motor assembly, in particular for railway drive, according to claim 1 or to any one of the Claims that directly or indirectly depend on claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be best understood upon perusal of the following description of a preferred embodiment, provided by way of a mere explanatory, non-limiting example, with reference to the accompanying drawings, wherein:

2

FIG. 1 shows an overall perspective view of an electric motor assembly for railway drive according to the invention;

FIG. 2 shows an exploded view of the electric motor assembly shown in FIG. 1;

5 FIG. 3 shows a longitudinal section of the electric motor assembly of FIG. 1;

FIG. 4 shows a cross section of the electric motor assembly of FIG. 1;

10 FIG. 5 shows a perspective view of a silencer device belonging to the electric drive motor assembly shown in FIGS. 1-4;

FIG. 6 shows a cross section A-A of the silencer device of FIG. 5; and

15 FIG. 7 shows a longitudinal section B-B of the silencer device of FIG. 5.

**DETAILED DESCRIPTION OF THE
INVENTION**

20 In FIGS. 1-4, number **100** indicates, as a whole, an electric drive motor assembly according to the technical teaches of the invention.

The electric drive motor assembly **100** substantially comprises:

25 an electric drive motor **10** (FIGS. 2, 3);
a ventilation and cooling device **20** (FIG. 2) for ventilating and cooling the electric drive motor **10** through cooling air; and
a draining device **30** to drain the ventilation and cooling air flow of the electric drive motor **10**.

30 More in detail and with reference to FIGS. 1-4, the electric drive motor **10** comprises, in a known manner, a casing **11**, substantially with a polyhedral shape, containing the greatest part of the functional devices of the electric drive motor **10**.

35 The casing **11** has a first axial opening **12** provided with an inlet grid **40** for a cooling air flow coming from the environment (FIG. 3).

40 The casing **11** is further provided with a second axial opening **13** for the outlet of the cooling air flow and for the re-directing thereof towards the aforesaid ventilation and cooling device **20** and the aforesaid draining device **30** (FIG. 3).

45 As shown more in detail in FIG. 3, the casing **11** houses an electric stator **14** containing, in turn, an electric rotor **15**, which is fitted in a known manner onto a shaft **16** with longitudinal axis (X1).

50 With known means, which are not shown herein, the shaft **16** is mechanically connected to a drive system (not shown) of the train.

The power supply means of the electric stator **14** and of the electric rotor **15** are known and, therefore, will not be described in detail.

According to FIG. 2, the fan **21**, which belongs to the aforesaid ventilation and cooling device **20**, is fitted onto the shaft **16**.

The fan **21** is known and is shown more in detail in FIG. 4.

60 The fan **21** comprises a hub **21A**, which is fitted onto the shaft **16**; the hub **21A** being provided with blades **21B** (FIG. 3).

For a person skilled in the art it is obvious that, without going beyond the scope of protection of the invention, it is possible to adopt blades having different shapes, provided that they are suited to effectively carry out the suction of environmental air in order to cool down the electric motor **10**.

Indeed, the suction of cooling air must take place in an effective manner for both directions of rotation of the rotor **15** and, hence, of the fan **21**.

It is known, indeed, that in railway drive the same electric motor assembly **100** is used for both the forward and the reverse running of the vehicle on which it is mounted. This leads to the fact that, as a consequence, the rotor **15** and the fan **21** must have the chance to rotate around the longitudinal axis (**X1**) in the two possible rotation directions (forward and reverse running).

Furthermore, there must be an optimal cooling air suction both when the electric motor **10** is accelerating (for example, with the fan **21** rotating in a clockwise direction) and when the electric motor **10** is decelerating (for example, with the fan **21** rotating in a counterclockwise direction).

The draining device **30** used to drain the cooling air comprises a scroll **300** (FIG. 4), which surrounds the fan **21** and consists of an inner shell **301**, which is provided with a first series of upper openings **32, 33, 34** (FIG. 4) and a second series of lower openings **35, 36, 37**.

Advantageously, though not necessarily, the outer openings **32, 34** have a trapezoidal shape, whereas the middle opening **33** is shaped like a triangle (FIGS. 2, 4).

Similarly, advantageously, though not necessarily, the outer openings **35, 37** have a trapezoidal shape, whereas the middle opening **36** is shaped like a triangle (FIGS. 2, 4).

Obviously, the skilled person will advantageously choose the best conformation of the openings **32-37** depending on the shape of the blades **21B** and on the cooling air ventilation modes.

According to FIGS. 1 and 4, in particular, the inner shell **301** is contained in an outer shell **308**.

The outer shell **308** comprises, in turn, an upper half-shell **308A**, which faces the upper openings **32-34** made in the inner shell **301**, and a lower half-shell **308B**, which faces the lower openings **35-37** made in the inner shell **301**.

It should be pointed out (FIG. 4) that the outer wall **301*** of a first portion of the inner shell **301**, the inner wall **308A*** of the upper half-shell **308A**, a bottom wall **308A**** and a front wall **308A***** (FIG. 1) form a first arched channel **39A** (with the shape of a circle arc).

Similarly, the outer wall **301**** of a second portion of the inner shell **301**, the inner wall **308B*** of the lower half-shell **308B**, a bottom wall **308B**** and a front wall **308B***** (FIG. 1) form a second arched channel **39B** (i.e. with the shape of a circle arc, as well).

The assembly of the first arched channel **39A** and of the second arched channel **39B** forms the aforementioned scroll **300**.

Furthermore, the first arched channel **39A** and the second arched channel **39B** communicate with one another, from the fluidic point of view, only in a common outlet area **39C** for the cooling air.

The first arched channel **39A** is separate from the second arched channel **39B** by means of an interruption area **50** (FIGS. 1, 4), so as to avoid that at least a portion of the air is continuously recirculated in a substantially stationary manner in the two arched channels **39A, 39B** having similar dimensions and sizes. In other words, the presence of the interruption area **50** and, hence, of two distinct arched channels **39A, 39B** forbids the formation of stationary vortices inside the scroll **300**, which would translate into an undesired loss of power of the system.

Furthermore, it is well known that the formation of stationary vortices could increase the noise of the system.

Moreover, since, as already mentioned above, the scroll **300** is divided into two arched channels **39A, 39B**, which

communicate with one another, from the fluidic point of view, only in a common outlet area **39C**, the fan **21** operates in a satisfying manner in both its possible rotation directions (clockwise and counterclockwise) around the longitudinal axis (**X1**), furthermore avoiding losses of power due to the possible formation of stationary vortices in the scroll **300**.

The common outlet area **39C** is advantageously provided with a deflector **41**, which separately guides the two air flows and, for example, prevents the air flowing out of the first arched channel **39A** from inappropriately flowing into the second arched channel **39B** or vice versa.

In other words, each arched channel **39A, 39B** substantially has a respective circle arc shape and is arranged peripherally relative to the aforesaid longitudinal axis (**X1**).

The common outlet **39C** represents the mouth of a third straight channel **39D**, advantageously, though not necessarily, with a square or rectangular cross section, having a longitudinal axis (**X2**) parallel to the longitudinal axis (**X1**) of the shaft **16** and of the motor **10** (FIGS. 1-4).

Since the common outlet **39C** also represents the mouth of the third straight channel **39D**, the scroll **300** and the third straight channel **39D** are placed in series with respect to each other.

Advantageously, though not necessarily, the third straight channel **39D** is beside the electric drive motor **10**.

Hence, all the cooling air, both in a rotation direction of the blades **21B** and in the other one, axially flows along the third straight channel **39D** before flowing out of the system and being reintroduced into the environment.

To sum up, experiments have shown that, if in the end part of its path, the cooling air has a substantially laminar flow (anyway reducing the turbulent flow), there is a significant reduction in the sound emissions of the system.

The path of the cooling air is schematically shown in FIG. 1.

The environmental air (arrow (**F1**)) enters the system through the grid **40** (FIG. 3) sucked by the fan **21**. The cooling air crosses the actuator **14** and the rotor **15** of the electric motor **10** (arrow (**F2**)), then flows through the two peripheral arched channels **39A, 39B**, where it flows towards the common outlet **39C** (arrows (**F3**), (**F4**)).

In the area of the common outlet **39C** the cooling air gets into the straight channel **39D** (arrow (**F5**)), in order to then be reintroduced into the environment (arrow (**F6**)).

Advantageously, though not necessarily, all or part of the channels **39A, 39B** are coated, on the inside, with a properly protected layer **60** of sound absorbing material (FIGS. 5, 6, 7).

To sum up, the draining device **30** is provided with a silencer device **70** comprising the straight channel **39D** and, if available, the layer **60** of sound absorbing material.

A further positive effect on the reduction of the noise of the system is provided by the scroll **300** consisting of the two separate arched channels **39A, 39B**, where no stationary vortices are created.

The main advantage of the invention lies in the fact that, thanks to the innovative shapes and arrangements of the cooling air draining channels, there is a significant reduction in the sound emissions of the electric motor assembly for railway drive, with a relative improvement of the operators working conditions and of the passengers comfort.

A further advantage lies in the fact that, since the scroll is divided into two separate arched channels communicating with one another only in a common outlet area, there are no vortices on the inside thereof in both rotation directions

5

(clockwise and counterclockwise) of the fan. This positively affects the reduction of power dissipation and the reduction of the noise of the system.

The invention claimed is:

1. An electric motor assembly for railway drive; the motor assembly comprising:
 - electric drive means;
 - ventilation and cooling means for ventilating and cooling said electric drive means through cooling air; said ventilation and cooling means being fitted onto the shaft of said electric drive means; and
 - draining means for draining the ventilation and cooling air flow used to ventilate and cool said electric drive means; said draining means being provided with silencer means for the cooling air flow;
 the motor assembly being characterized in that said silencer means comprise at least one straight channel to reduce the turbulent flow into a substantially laminar flow of the ventilation and cooling air flowing out of said draining means;
 - and in that said draining means furthermore comprise, a scroll surrounding ventilation means, which comprises two separate arched channels; said arched channels communicating with one another, from the fluidic point of view, only in a common outlet area for the ventilation and cooling air; said scroll and said at least one straight channel being placed in series with respect to each other;
 - wherein said scroll comprises an inner shell, which is provided with a first series of upper openings and with a second series of lower openings.
2. Motor assembly, according to claim 1, characterized in that the longitudinal axis (X2) of said straight channel is parallel to the longitudinal axis (X1) of said electric drive means.
3. Motor assembly, according to claim 1, characterized in that said straight channel has a square or rectangular cross section.
4. Motor assembly, according to claim 1, characterized in that some openings of the first series of the upper openings and the second series of lower openings have a trapezoidal shape, whereas other openings of the first series of the upper openings and the second series of lower openings are shaped like a triangle.
5. Motor assembly, according to claim 1, characterized in that said inner shell is contained in an outer shell.
6. Motor assembly, according to claim 5, characterized in that said outer shell comprises an upper half-shell, which faces the upper openings, and a lower half-shell, which faces the lower openings.

6

7. Motor assembly, according to claim 6, characterized in that the outer wall of a first portion of said inner shell, the inner wall of the upper half-shell, a bottom wall and a front face form a first arched channel; and in that the outer wall of a second portion of said inner shell, the inner wall of the lower half-shell, a bottom wall and a front wall form a second arched channel.

8. Motor assembly, according to claim 7, characterized in that said common outlet area is provided with deflector means, which are designed to guide the two air flows flowing out of said arched channels.

9. Motor assembly, according to claim 1, characterized in that said straight channel and/or said arched channels is/are coated with at least one layer of sound absorbing material.

10. An electric motor assembly for railway drive; the motor assembly comprising:
 - electric drive means which comprises a shaft rotatable about its axis (X1);
 - ventilation and cooling means for ventilating and cooling said electric drive means through cooling air; said ventilation and cooling means comprising a fan fitted onto the shaft; and
 - draining means for draining a cooling air flow of the cooling air used to ventilate and cool said electric drive means; said draining means being provided with silencer means for the cooling air flow;
 - said silencer means comprises at least one straight channel to reduce the turbulent flow into a substantially laminar flow of the cooling air flowing out of said draining means;
 - said draining means furthermore comprising a shell surrounding said fan;
 - wherein said draining means further comprises two arched channels arranged peripherally relative to said axis (X1) and separated from each other by means of an interruption area, so as to directly communicate with one another, from a fluidic point of view, only in a common outlet area for the cooling air;
 - wherein said shell comprises a series of first openings to allow the cooling air flowing from said fan to one of said two arched channels, and a series of second openings, to allow the cooling air flowing from said fan to the other of said two arched channels;
 - said common outlet area being a mouth of said at least one straight channel so that said shell and said at least one straight channel are placed in series with respect to each other.

* * * * *